

## TFT LCD Approval Specification

# MODEL NO.: N150X3 - L09

Customer: \_\_\_\_\_

Approved by: \_\_\_\_\_

Note:

| Liquid Crystal Display Division                                                     |                                                                                     |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| QRA Division.                                                                       | OA Head Division.                                                                   |
| Approval                                                                            | Approval                                                                            |
|  |  |



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**REVISION HISTORY**

| Version | Date       | Page<br>(New) | Section | Description                                 |
|---------|------------|---------------|---------|---------------------------------------------|
| Ver 1.0 | Jan.31 '05 | All           | All     | Perminaliary specification was first issued |
| Ver 2.0 | May.23 '05 | 9             | 3.3     | Added EDID code                             |
| Ver 2.1 | Aug.31 '05 | 25            | 10      | Modified Carton & pallet                    |



## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

N150X3- L09 is a 15.0" TFT Liquid Crystal Display module. This module supports 1024 x 768 XGA mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction.

### 1.2 FEATURES

- Thin and Light Weight
- XGA (1024 x 768 pixels) resolution
- DE only mode
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 1 pixel/clock
- SPWG (Standard Panel Working Group) Style B compatible
- Single CCFL

### 1.3 APPLICATION

- TFT LCD Notebook

### 1.4 GENERAL SPECIFICATIONS

| Item               | Specification                           | Unit  | Note |
|--------------------|-----------------------------------------|-------|------|
| Active Area        | 304.1 (H) x 228.1 (V) (15.0" diagonal)  | mm    | (1)  |
| Bezel Opening Area | 307.8 (H) x 231.6 (V)                   | mm    |      |
| Driver Element     | a-si TFT active matrix                  | -     | -    |
| Pixel Number       | 1024 x R.G.B. x 768                     | pixel | -    |
| Pixel Pitch        | 0.297 (H) x 0.297 (V)                   | mm    | -    |
| Pixel Arrangement  | RGB vertical stripe                     | -     | -    |
| Display Colors     | 262,144                                 | color | -    |
| Transmissive Mode  | Normally white                          | -     | -    |
| Surface Treatment  | Hard coating (3H), Anti-glare (Haze 25) | -     | -    |

### 1.5 MECHANICAL SPECIFICATIONS

| Item        |               | Min.  | Typ.  | Max.  | Unit | Note |
|-------------|---------------|-------|-------|-------|------|------|
| Module Size | Horizontal(H) | 316.8 | 317.3 | 317.8 | mm   | (1)  |
|             | Vertical(V)   | 241.5 | 242   | 242.5 | mm   | (1)  |
|             | Depth(D)      | -     | 5.7   | 6.0   | mm   | (1)  |
| Weight      |               | -     | 550   | 565   | g    | -    |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.



## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item                          | Symbol           | Value |                | Unit | Note          |
|-------------------------------|------------------|-------|----------------|------|---------------|
|                               |                  | Min.  | Max.           |      |               |
| Storage Temperature           | T <sub>ST</sub>  | -20   | +60            | °C   | (1)           |
| Storage Humidity              | H <sub>ST</sub>  | 10    | 90             | %RH  | (1)           |
| Operating Ambient Temperature | T <sub>OP</sub>  | 0     | +50            | °C   | (1), (2)      |
| Operating Ambient Humidity    | H <sub>OP</sub>  | 20    | 90             | %RH  | (1)           |
| Shock (Non-Operating)         | S <sub>NOP</sub> | -     | 50/18<br>220/2 | G/ms | (3), (4), (5) |
| Vibration (Non-Operating)     | V <sub>NOP</sub> | -     | 1.5/10-200     | G/Hz | (4), (5)      |

Note (1) (a) 90 %RH Max. (Ta ≤ 40 °C).

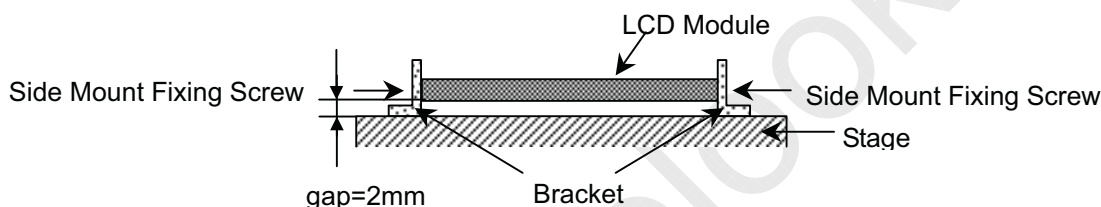
(b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C).

(c) No condensation.

Note (2) The temperature of panel surface should be 0°C min. and 50 °C max.

Note (3) Condition for 50/18 G/ms is Rectangle Wave. Condition for 220/2 G/ms is Half Sine Wave.

Note (4) The fixing condition is shown as below:



Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.


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OPTOELECTRONICS CORP.

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Model No.: N150X3 - L09

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## 2.2 ELECTRICAL ABSOLUTE RATINGS

### 2.2.1 TFT LCD MODULE

| Item                 | Symbol   | Value |              | Unit | Note |
|----------------------|----------|-------|--------------|------|------|
|                      |          | Min.  | Max.         |      |      |
| Power Supply Voltage | $V_{CC}$ | -0.3  | +4.0         | V    | (1)  |
| Logic Input Voltage  | $V_{IN}$ | -0.3  | $V_{CC}+0.3$ | V    |      |

### 2.2.2 BACKLIGHT UNIT

| Item           | Symbol | Value |        | Unit              | Note                             |
|----------------|--------|-------|--------|-------------------|----------------------------------|
|                |        | Min.  | Max.   |                   |                                  |
| Lamp Voltage   | $V_L$  | -     | (2.5K) | $V_{RMS}$         | (1), (2), $I_L = 6.0 \text{ mA}$ |
| Lamp Current   | $I_L$  | 2.0   | 6.5    | $\text{mA}_{RMS}$ |                                  |
| Lamp Frequency | $F_L$  | 50    | 80     | KHz               |                                  |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to 3.2 for further information).

## 3. ELECTRICAL CHARACTERISTICS

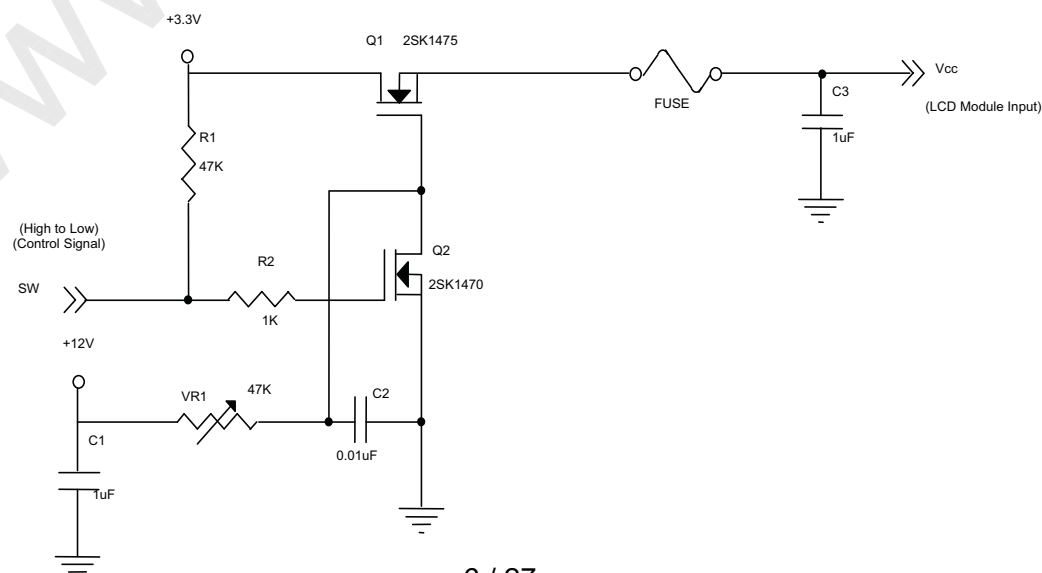
### 3.1 TFT LCD MODULE

 $T_a = 25 \pm 2^\circ \text{C}$ 

| Parameter                    |           | Symbol     | Value |       |      | Unit | Note |
|------------------------------|-----------|------------|-------|-------|------|------|------|
|                              |           |            | Min.  | Typ.  | Max. |      |      |
| Power Supply Voltage         |           | $V_{CC}$   | 3.0   | 3.3   | 3.6  | V    | -    |
| Ripple Voltage               |           | $V_{RP}$   | -     | 100   | -    | mV   | -    |
| Rush Current                 |           | $I_{RUSH}$ | -     | -     | 1.5  | A    | (2)  |
| Power Supply Current         | White     | $I_{CC}$   | -     | 300   | 350  | mA   | (3)a |
|                              | Black     |            | -     | 350   | 400  | mA   | (3)b |
| Logical Input Voltage (LVDS) | "H" Level | $V_{IL}$   | -     | -     | +100 | mV   | -    |
|                              | "L" Level | $V_{IH}$   | -100  | -     | -    | mV   | -    |
| Terminating Resistor         |           | $R_T$      | -     | 100   | -    | Ohm  | -    |
| Power per EBL WG             |           | $P_{EBL}$  | -     | 3.176 | -    | W    | (4)  |

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:



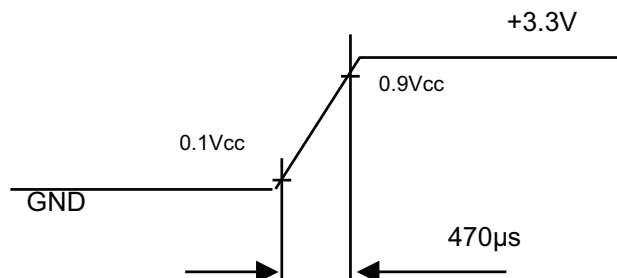

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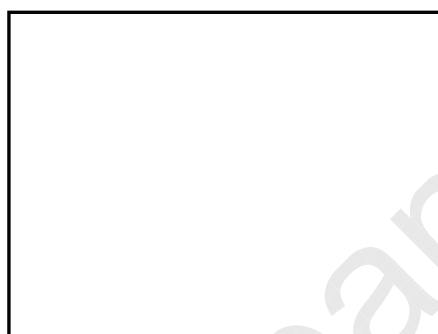
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### Vcc rising time is 470 $\mu$ s



Note (3) The specified power supply current is under the conditions at  $V_{cc} = 3.3\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ ,  $f_v = 60\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



Active Area

Note (4) The specified power are the sum of LCD panel electronics input power and the inverter input power. Test conditions are as follows.

- $V_{cc} = 3.3\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ ,  $f_v = 60\text{ Hz}$ ,
- The pattern used is a black and white 32 x 36 checkerboard, slide #100 from the VESA file "Flat Panel Display Monitor Setup Patterns", FPDMSU.ppt.
- Luminance: 60 nits.
- The inverter used is provided from O2Micro (www.o2micro.com). Please contact O2Mirco for detail information. CMO doesn't provide the inverter in this product.

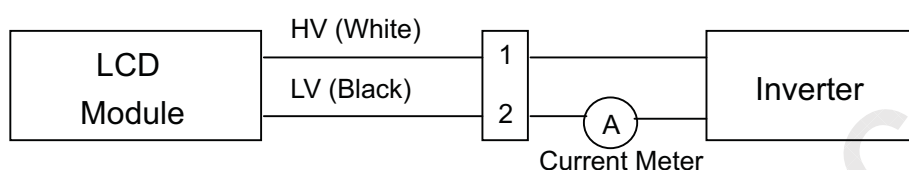


## 3.2 BACKLIGHT UNIT

 $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ 

| Parameter            | Symbol   | Value  |      |                               | Unit              | Note                       |
|----------------------|----------|--------|------|-------------------------------|-------------------|----------------------------|
|                      |          | Min.   | Typ. | Max.                          |                   |                            |
| Lamp Input Voltage   | $V_L$    | 627    | 660  | 693                           | $V_{RMS}$         | $I_L = 6.0\text{ mA}$      |
| Lamp Current         | $I_L$    | 2.0    | 6.0  | 6.5                           | $\text{mA}_{RMS}$ | (1)                        |
| Lamp Turn On Voltage | $V_s$    | ---    | ---  | 1165 (25 $^{\circ}\text{C}$ ) | $V_{RMS}$         | (2)                        |
|                      |          | ---    | ---  | 1400 (0 $^{\circ}\text{C}$ )  | $V_{RMS}$         | (2)                        |
| Operating Frequency  | $F_L$    | 50     | ---  | 80                            | KHz               | (3)                        |
| Lamp Life Time       | $L_{BL}$ | 15,000 |      | -                             | Hrs               | (5)                        |
| Power Consumption    | $P_L$    | -      | 3.96 | -                             | W                 | (4), $I_L = 6.0\text{ mA}$ |

Note (1) Lamp current is measured by utilizing a high frequency current meter as shown below:



Note (2) The voltage shown above should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.

Note (3) The lamp frequency may produce interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4)  $P_L = I_L \times V_L$

Note (5) The lifetime of lamp can be defined as the time in which it continues to operate under the condition  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$  and  $I_L = 6.0\text{ mA}_{RMS}$  until one of the following events occurs:

- (a) When the brightness becomes or lower than 50% of its original value.
- (b) When the effective ignition length becomes or lower than 80% of its original value. (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid producing too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.



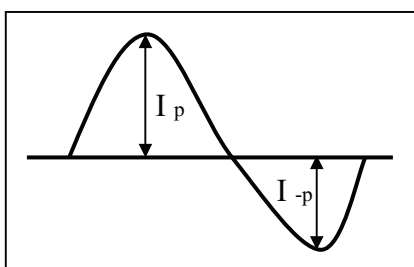


The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform. (Unsymmetrical ratio is less than 10%) Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and spike wave. Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.

Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp. It shall help increase the lamp lifetime and reduce its leakage current.

- The asymmetry rate of the inverter waveform should be 10% below;
- The distortion rate of the waveform should be within  $\sqrt{2} \pm 10\%$ ;

The ideal sine wave form shall be symmetric in positive and negative polarities.



\* Asymmetry rate:

$$|I_p - I_{-p}| / I_{rms} * 100\%$$

\* Distortion rate

$$I_p \text{ (or } I_{-p}) / I_{rms}$$



### 3.3 EDID DATA

The following data is based on VESA Enhanced EDID proposal.

| Byte #<br>(decimal) | Byte<br>(hex) | Field Name and Comments                             | Value<br>(hex) | Value<br>(binary) |
|---------------------|---------------|-----------------------------------------------------|----------------|-------------------|
| 0                   | 0             | Header                                              | 00             | 00000000          |
| 1                   | 1             | Header                                              | FF             | 11111111          |
| 2                   | 2             | Header                                              | FF             | 11111111          |
| 3                   | 3             | Header                                              | FF             | 11111111          |
| 4                   | 4             | Header                                              | FF             | 11111111          |
| 5                   | 5             | Header                                              | FF             | 11111111          |
| 6                   | 6             | Header                                              | FF             | 11111111          |
| 7                   | 7             | Header                                              | 00             | 00000000          |
| 8                   | 8             | EISA ID manufacturer name ("CMO")                   | 0D             | 00001101          |
| 9                   | 9             | EISA ID manufacturer name (Compressed ASCII)        | AF             | 10101111          |
| 10                  | 0A            | ID product code                                     | 13             | 00010011          |
| 11                  | 0B            | ID product code                                     | 15             | 00010101          |
| 12                  | 0C            | ID S/N (fixed "0")                                  | 00             | 00000000          |
| 13                  | 0D            | ID S/N (fixed "0")                                  | 00             | 00000000          |
| 14                  | 0E            | ID S/N (fixed "0")                                  | 00             | 00000000          |
| 15                  | 0F            | ID S/N (fixed "0")                                  | 00             | 00000000          |
| 16                  | 10            | Week of manufacture (fixed week code)               | 00             | 00000000          |
| 17                  | 11            | Year of manufacture (fixed year code)               | 00             | 00000000          |
| 18                  | 12            | EDID structure version # ("1")                      | 01             | 00000001          |
| 19                  | 13            | EDID revision # ("3")                               | 03             | 00000011          |
| 20                  | 14            | Video I/P definition ("digital")                    | 80             | 10000000          |
| 21                  | 15            | Max H image size ("30.4128 cm")                     | 1E             | 00011110          |
| 22                  | 16            | Max V image size ("22.8096 cm")                     | 17             | 00010111          |
| 23                  | 17            | Display Gamma (Gamma = "2.2")                       | 78             | 01111000          |
| 24                  | 18            | Feature support ("Active off, RGB Color")           | 0A             | 00001010          |
| 25                  | 19            | Red/Green (Rx1, Rx0, Ry1, Ry0, Gx1, Gx0, Gy1, Gy0)  | 77             | 01110111          |
| 26                  | 1A            | Blue/White (Bx1, Bx0, By1, By0, Wx1, Wx0, Wy1, Wy0) | F1             | 11110001          |
| 27                  | 1B            | Red-x (Rx = "0.626")                                | A0             | 10100000          |
| 28                  | 1C            | Red-y (Ry = "0.355")                                | 5A             | 01011010          |
| 29                  | 1D            | Green-x (Gx = "0.294")                              | 4B             | 01001011          |
| 30                  | 1E            | Green-y (Gy = "0.589")                              | 96             | 10010110          |
| 31                  | 1F            | Blue-x (Bx = "0.144")                               | 24             | 00100100          |
| 32                  | 20            | Blue-y (By = "0.097")                               | 18             | 00011000          |
| 33                  | 21            | White-x (Wx = "0.309")                              | 4F             | 01001111          |
| 34                  | 22            | White-y (Wy = "0.329")                              | 54             | 01010100          |
| 35                  | 23            | Established timings 1                               | 00             | 00000000          |
| 36                  | 24            | Established timings 2                               | 08             | 00001000          |
| 37                  | 25            | Manufacturer's reserved timings                     | 00             | 00000000          |
| 38                  | 26            | Standard timing ID # 1                              | 01             | 00000001          |
| 39                  | 27            | Standard timing ID # 1                              | 01             | 00000001          |
| 40                  | 28            | Standard timing ID # 2                              | 01             | 00000001          |
| 41                  | 29            | Standard timing ID # 2                              | 01             | 00000001          |



|    |    |                                                                                            |    |          |
|----|----|--------------------------------------------------------------------------------------------|----|----------|
| 42 | 2A | Standard timing ID # 3                                                                     | 01 | 00000001 |
| 43 | 2B | Standard timing ID # 3                                                                     | 01 | 00000001 |
| 44 | 2C | Standard timing ID # 4                                                                     | 01 | 00000001 |
| 45 | 2D | Standard timing ID # 4                                                                     | 01 | 00000001 |
| 46 | 2E | Standard timing ID # 5                                                                     | 01 | 00000001 |
| 47 | 2F | Standard timing ID # 5                                                                     | 01 | 00000001 |
| 48 | 30 | Standard timing ID # 6                                                                     | 01 | 00000001 |
| 49 | 31 | Standard timing ID # 6                                                                     | 01 | 00000001 |
| 50 | 32 | Standard timing ID # 7                                                                     | 01 | 00000001 |
| 51 | 33 | Standard timing ID # 7                                                                     | 01 | 00000001 |
| 52 | 34 | Standard timing ID # 8                                                                     | 01 | 00000001 |
| 53 | 35 | Standard timing ID # 8                                                                     | 01 | 00000001 |
| 54 | 36 | Detailed timing description # 1 Pixel clock ("65 MHz")                                     | 64 | 01100100 |
| 55 | 37 | # 1 Pixel clock (hex LSB first)                                                            | 19 | 00011001 |
| 56 | 38 | # 1 H active ("1024")                                                                      | 00 | 00000000 |
| 57 | 39 | # 1 H blank ("320")                                                                        | 40 | 01000000 |
| 58 | 3A | # 1 H active : H blank ("1024 : 320")                                                      | 41 | 01000001 |
| 59 | 3B | # 1 V active ("768")                                                                       | 00 | 00000000 |
| 60 | 3C | # 1 V blank ("38")                                                                         | 26 | 00100110 |
| 61 | 3D | # 1 V active : V blank ("768 : 38")                                                        | 30 | 00110000 |
| 62 | 3E | # 1 H sync offset ("24")                                                                   | 18 | 00011000 |
| 63 | 3F | # 1 H sync pulse width ("136")                                                             | 88 | 10001000 |
| 64 | 40 | # 1 V sync offset : V sync pulse width ("3 : 6")                                           | 36 | 00110110 |
| 65 | 41 | # 1 H sync offset : H sync pulse width : V sync offset : V sync width ("24 : 136 : 3 : 6") | 00 | 00000000 |
| 66 | 42 | # 1 H image size ("304.128 mm")                                                            | 30 | 00110000 |
| 67 | 43 | # 1 V image size ("228.096 mm")                                                            | E4 | 11100100 |
| 68 | 44 | # 1 H image size : V image size ("304 : 228")                                              | 10 | 00010000 |
| 69 | 45 | # 1 H boarder ("0")                                                                        | 00 | 00000000 |
| 70 | 46 | # 1 V boarder ("0")                                                                        | 00 | 00000000 |
| 71 | 47 | # 1 Non-interlaced, Normal, no stereo, Separate sync, H/V pol Negatives                    | 18 | 00011000 |
| 72 | 48 | Detailed timing description # 2                                                            | 00 | 00000000 |
| 73 | 49 | # 2 Flag                                                                                   | 00 | 00000000 |
| 74 | 4A | # 2 Reserved                                                                               | 00 | 00000000 |
| 75 | 4B | # 2 FE (hex) defines ASCII string (Model Name "N150X3-L09", ASCII)                         | FE | 11111110 |
| 76 | 4C | # 2 Flag                                                                                   | 00 | 00000000 |
| 77 | 4D | # 2 1st character of name ("N")                                                            | 4E | 01001110 |
| 78 | 4E | # 2 2nd character of name ("1")                                                            | 31 | 00110001 |
| 79 | 4F | # 2 3rd character of name ("5")                                                            | 35 | 00110101 |
| 80 | 50 | # 2 4th character of name ("0")                                                            | 30 | 00110000 |
| 81 | 51 | # 2 5th character of name ("X")                                                            | 58 | 01011000 |
| 82 | 52 | # 2 6th character of name ("3")                                                            | 33 | 00110011 |
| 83 | 53 | # 2 7th character of name ("-")                                                            | 2D | 00101101 |
| 84 | 54 | # 2 8th character of name ("L")                                                            | 4C | 01001100 |
| 85 | 55 | # 2 9th character of name ("0")                                                            | 30 | 00110000 |
| 86 | 56 | # 2 10th character of name ("9")                                                           | 39 | 00111001 |



|     |    |                                                                             |    |          |
|-----|----|-----------------------------------------------------------------------------|----|----------|
| 87  | 57 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 0A | 00001010 |
| 88  | 58 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 89  | 59 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 90  | 5A | Detailed timing description # 3                                             | 00 | 00000000 |
| 91  | 5B | # 3 Flag                                                                    | 00 | 00000000 |
| 92  | 5C | # 3 Reserved                                                                | 00 | 00000000 |
| 93  | 5D | # 3 FE (hex) defines ASCII string (Vendor "CMO", ASCII)                     | FE | 11111110 |
| 94  | 5E | # 3 Flag                                                                    | 00 | 00000000 |
| 95  | 5F | # 3 1st character of string ("C")                                           | 43 | 01000011 |
| 96  | 60 | # 3 2nd character of string ("M")                                           | 4D | 01001101 |
| 97  | 61 | # 3 3rd character of string ("O")                                           | 4F | 01001111 |
| 98  | 62 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 0A | 00001010 |
| 99  | 63 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 100 | 64 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 101 | 65 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 102 | 66 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 103 | 67 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 104 | 68 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 105 | 69 | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 106 | 6A | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 107 | 6B | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 108 | 6C | Detailed timing description # 4                                             | 00 | 00000000 |
| 109 | 6D | # 4 Flag                                                                    | 00 | 00000000 |
| 110 | 6E | # 4 Reserved                                                                | 00 | 00000000 |
| 111 | 6F | # 4 FE (hex) defines ASCII string (Model Name "N150X3-L09", ASCII)          | FE | 11111110 |
| 112 | 70 | # 4 Flag                                                                    | 00 | 00000000 |
| 113 | 71 | # 4 1st character of name ("N")                                             | 4E | 01001110 |
| 114 | 72 | # 4 2nd character of name ("1")                                             | 31 | 00110001 |
| 115 | 73 | # 4 3rd character of name ("5")                                             | 35 | 00110101 |
| 116 | 74 | # 4 4th character of name ("0")                                             | 30 | 00110000 |
| 117 | 75 | # 4 5th character of name ("X")                                             | 58 | 01011000 |
| 118 | 76 | # 4 6th character of name ("3")                                             | 33 | 00110011 |
| 119 | 77 | # 4 7th character of name ("-")                                             | 2D | 00101101 |
| 120 | 78 | # 4 8th character of name ("L")                                             | 4C | 01001100 |
| 121 | 79 | # 4 9th character of name ("0")                                             | 30 | 00110000 |
| 122 | 7A | # 4 10th character of name ("9")                                            | 39 | 00111001 |
| 123 | 7B | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 0A | 00001010 |

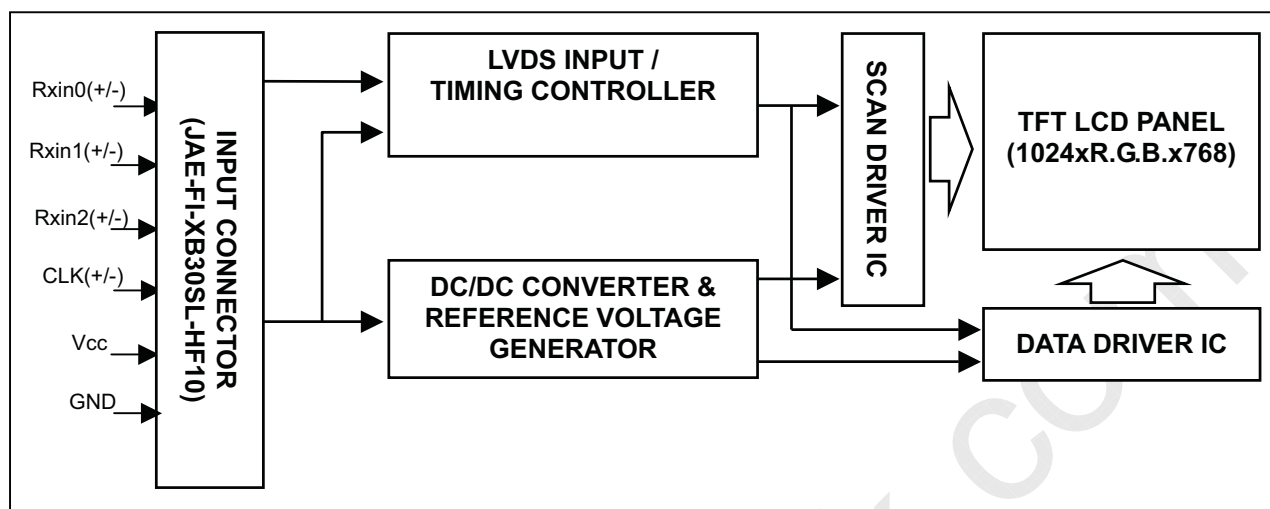


|     |    |                                                                             |    |          |
|-----|----|-----------------------------------------------------------------------------|----|----------|
| 124 | 7C | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 125 | 7D | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| 126 | 7E | Extension flag                                                              | 00 | 00000000 |
| 127 | 7F | Checksum                                                                    | 0E | 00001110 |



## 4. BLOCK DIAGRAM

### TFT LCD MODULE



## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 TFT LCD MODULE

| Pin | Symbol | Description                   | Polarity | Remark               |
|-----|--------|-------------------------------|----------|----------------------|
| 1   | Vss    | Ground                        |          |                      |
| 2   | Vcc    | Power Supply +3.3 V (typical) |          |                      |
| 3   | Vcc    | Power Supply +3.3 V (typical) |          |                      |
| 4   | NC     | Non-Connection                |          |                      |
| 5   | NC     | Non-Connection                |          |                      |
| 6   | NC     | Non-Connection                |          |                      |
| 7   | NC     | Non-Connection                |          | -                    |
| 8   | Rxin0- | LVDS Differential Data Input  | Negative | R0~R5,G0             |
| 9   | Rxin0+ | LVDS Differential Data Input  | Positive |                      |
| 10  | Vss    | Ground                        |          |                      |
| 11  | Rxin1- | LVDS Differential Data Input  | Negative | G1~G5,B0,B1          |
| 12  | Rxin1+ | LVDS Differential Data Input  | Positive |                      |
| 13  | Vss    | Ground                        |          |                      |
| 14  | Rxin2- | LVDS Differential Data Input  | Negative | B2~B5,DE,Hsync,Vsync |
| 15  | Rxin2+ | LVDS Differential Data Input  | Positive |                      |
| 16  | Vss    | Ground                        |          |                      |
| 17  | CLK-   | LVDS Clock Data Input         | Negative | LVDS Level Clock     |
| 18  | CLK+   | LVDS Clock Data Input         | Positive |                      |
| 19  | Vss    | Ground                        |          |                      |
| 20  | NC     | Non-Connection                |          |                      |
| 21  | NC     | Non-Connection                |          |                      |
| 22  | Vss    | Ground                        |          |                      |
| 23  | NC     | Non-Connection                |          |                      |
| 24  | NC     | Non-Connection                |          |                      |



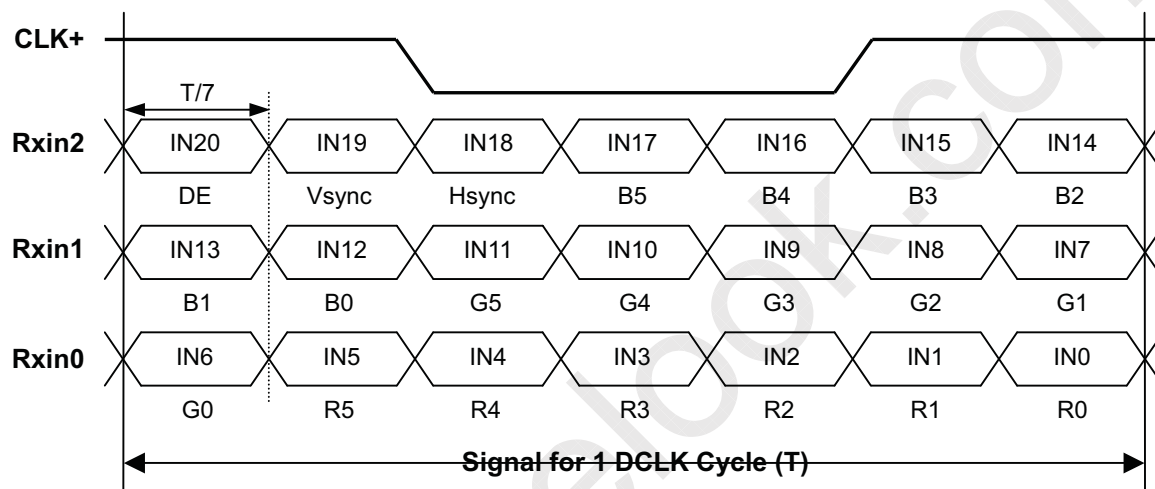
|    |     |                |  |  |
|----|-----|----------------|--|--|
| 25 | Vss | Ground         |  |  |
| 26 | NC  | Non-Connection |  |  |
| 27 | NC  | Non-Connection |  |  |
| 28 | Vss | Ground         |  |  |
| 29 | NC  | Non-Connection |  |  |
| 30 | NC  | Non-Connection |  |  |

Note (1) Connector Part No.: JAE-FI-XB30SL-HF10 or equivalent

Note (2) User's connector Part No: JAE-FI-X30C2L or equivalent

Note (3) The first pixel is even.

## 5.2 TIMING DIAGRAM OF LVDS INPUT SIGNAL





### 5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

| Color               |               | Data Signal |    |    |    |    |    |       |    |    |    |    |    |      |    |    |    |    |    |
|---------------------|---------------|-------------|----|----|----|----|----|-------|----|----|----|----|----|------|----|----|----|----|----|
|                     |               | Red         |    |    |    |    |    | Green |    |    |    |    |    | Blue |    |    |    |    |    |
|                     |               | R5          | R4 | R3 | R2 | R1 | R0 | G5    | G4 | G3 | G2 | G1 | G0 | B5   | B4 | B3 | B2 | B1 | B0 |
| Basic Colors        | Black         | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Red           | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green         | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Blue          | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Cyan          | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Magenta       | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Yellow        | 1           | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | White         | 1           | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  |
| Gray Scale Of Red   | Red(0)/Dark   | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Red(1)        | 0           | 0  | 0  | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Red(2)        | 0           | 0  | 0  | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | Red(61)       | 1           | 1  | 1  | 1  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Red(62)       | 1           | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
| Red(63)             | 1             | 1           | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
| Gray Scale Of Green | Green(0)/Dark | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green(1)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green(2)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 1  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | Green(61)     | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 0  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green(62)     | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
| Green(63)           | 0             | 0           | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  |    |
| Gray Scale Of Blue  | Blue(0)/Dark  | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Blue(1)       | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 1  |
|                     | Blue(2)       | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 1  | 0  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | Blue(61)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 0  | 1  | 1  |
|                     | Blue(62)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 0  | 0  |
| Blue(63)            | 0             | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 1  | 1  | 1    | 1  | 1  | 1  | 1  |    |

Note (1) 0: Low Level Voltage, 1: High Level Voltage





## 6. INTERFACE TIMING

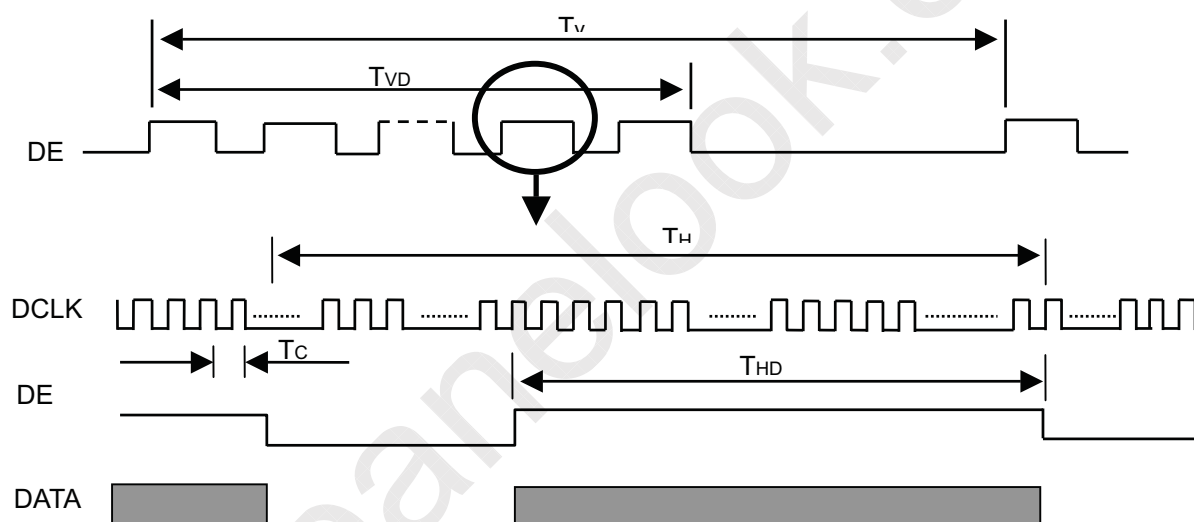
### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

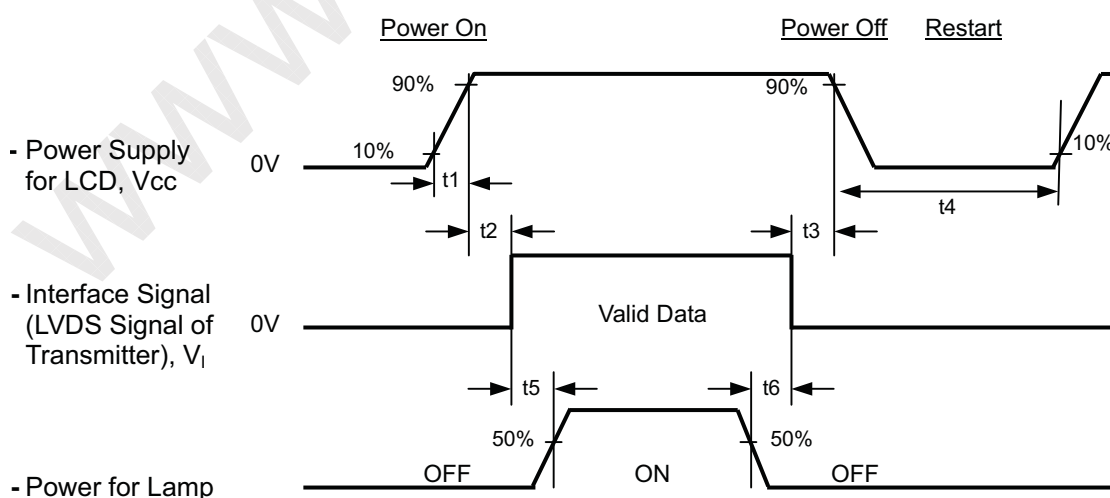
| Signal | Item                             | Symbol | Min. | Typ. | Max. | Unit | Note |
|--------|----------------------------------|--------|------|------|------|------|------|
| DCLK   | Frequency                        | 1/Tc   | 50   | 65   | 68   | MHz  | -    |
| DE     | Frame Time Cycle                 | TV     | 771  | 806  | 850  | TH   | -    |
|        | Vertical Active Display Period   | TVD    | 768  | 768  | 768  | TH   | -    |
|        | One Line Scanning Time Cycle     | TH     | 1200 | 1344 | 1600 | Tc   | -    |
|        | Horizontal Active Display Period | THD    | 1024 | 1024 | 1024 | Tc   | -    |

Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

#### INPUT SIGNAL TIMING DIAGRAM



### 6.2 POWER ON/OFF SEQUENCE





## Timing Specifications:

$$0.47 < t_1 \leq 10 \text{ msec}$$

$$0 < t_2 \leq 50 \text{ msec}$$

$$0 < t_3 \leq 50 \text{ msec}$$

$$t_4 \geq 500 \text{ msec}$$

$$t_5 \geq 200 \text{ msec}$$

$$t_6 \geq 200 \text{ msec}$$

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.



## 7. OPTICAL CHARACTERISTICS

### 7.1 TEST CONDITIONS

| Item                       | Symbol                                                        | Value | Unit |
|----------------------------|---------------------------------------------------------------|-------|------|
| Ambient Temperature        | Ta                                                            | 25±2  | °C   |
| Ambient Humidity           | Ha                                                            | 50±10 | %RH  |
| Supply Voltage             | V <sub>CC</sub>                                               | 3.3   | V    |
| Input Signal               | According to typical value in "3. ELECTRICAL CHARACTERISTICS" |       |      |
| Inverter Current           | I <sub>L</sub>                                                | 6.0   | mA   |
| Inverter Driving Frequency | F <sub>L</sub>                                                | 61    | KHz  |
| Inverter                   | Sumida H05 4915                                               |       |      |

The relative measurement methods of optical characteristics are shown in 6.2. The following items should be measured under the test conditions described in 6.1 and stable environment shown in Note (6).

### 7.2 OPTICAL SPECIFICATIONS

| Item                      |            | Symbol           | Condition                                        | Min.         | Typ.  | Max.              | Unit     | Note            |
|---------------------------|------------|------------------|--------------------------------------------------|--------------|-------|-------------------|----------|-----------------|
| Color Chromaticity        | Red        | R <sub>x</sub>   | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>CS-1000T | TYP<br>-0.03 | 0.589 | TYP<br>+0.03      | ---      | (1), (5)        |
|                           |            | R <sub>y</sub>   |                                                  |              | 0.338 |                   | ---      |                 |
|                           | Green      | G <sub>x</sub>   |                                                  |              | 0.316 |                   | ---      |                 |
|                           |            | G <sub>y</sub>   |                                                  |              | 0.532 |                   | ---      |                 |
|                           | Blue       | B <sub>x</sub>   |                                                  |              | 0.152 |                   | ---      |                 |
|                           |            | B <sub>y</sub>   |                                                  |              | 0.129 |                   | ---      |                 |
|                           | White      | W <sub>x</sub>   |                                                  |              | 0.313 |                   | ---      |                 |
|                           |            | W <sub>y</sub>   |                                                  |              | 0.329 |                   | ---      |                 |
| Center Luminance of White |            | L <sub>C</sub>   | 170                                              | 200          | ---   | cd/m <sup>2</sup> | (4), (5) |                 |
| Contrast Ratio            |            | CR               | 200                                              | 300          | ---   | ---               | (2), (6) |                 |
| Response Time             |            | T <sub>R</sub>   | $\theta_x=0^\circ, \theta_Y=0^\circ$             | ---          | 5     | 10                | ms       | (3)             |
|                           |            | T <sub>F</sub>   |                                                  | ---          | 11    | 16                | ms       |                 |
| White Variation           |            | δW               | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>CA-210   | ---          | 1.25  | 1.40              | ---      | (5), (6)        |
| Viewing Angle             | Horizontal | θ <sub>x</sub> + | CR≥10<br>CA-210                                  | 40           | 45    | ---               | Deg.     | (1), (2)<br>(5) |
|                           |            | θ <sub>x</sub> - |                                                  | 40           | 45    | ---               |          |                 |
|                           | Vertical   | θ <sub>y</sub> + |                                                  | 15           | 20    | ---               |          |                 |
|                           |            | θ <sub>y</sub> - |                                                  | 40           | 45    | ---               |          |                 |



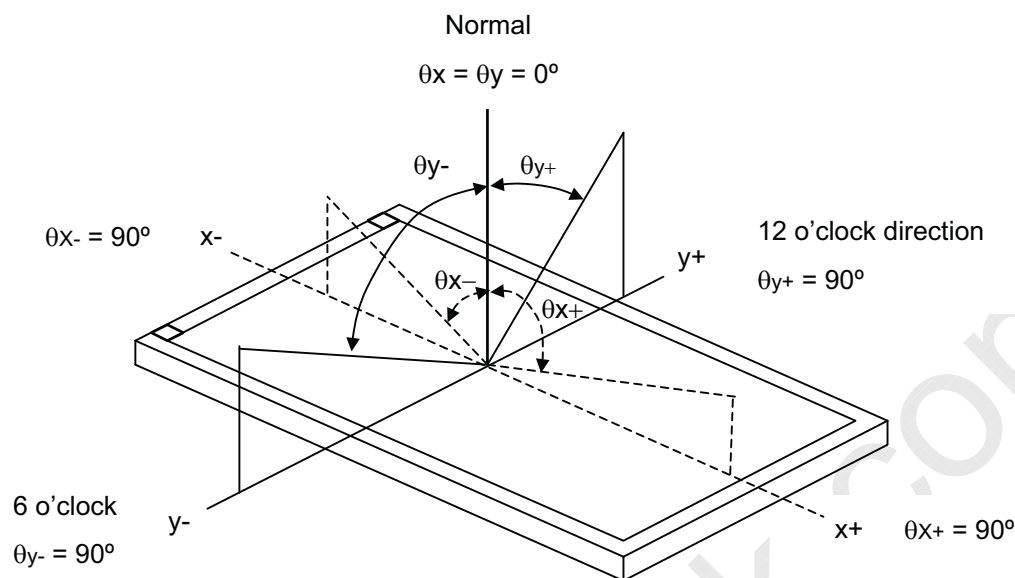
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Issued Date: Aug.31, 2005

Model No.: N150X3 - L09

**Approval**

Note (1) Definition of Viewing Angle ( $\theta_x$ ,  $\theta_y$ ):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

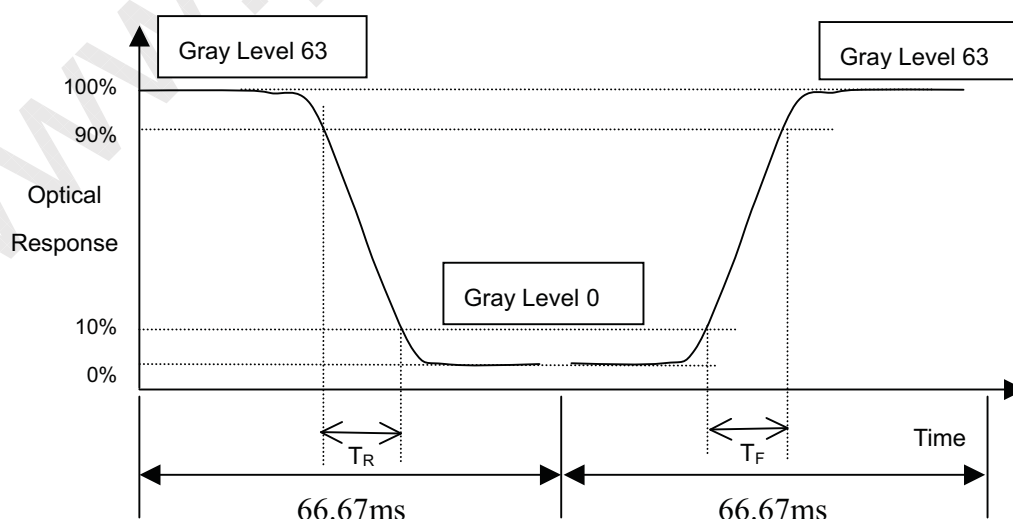
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (7).

Note (3) Definition of Response Time ( $T_R$ ,  $T_F$ ):





Note (4) Definition of Luminance of White ( $L_C$ ):

Measure the luminance of gray level 63 at center point

$$L_C = L(5)$$

$L(x)$  is corresponding to the luminance of the point X at Figure in Note (6).

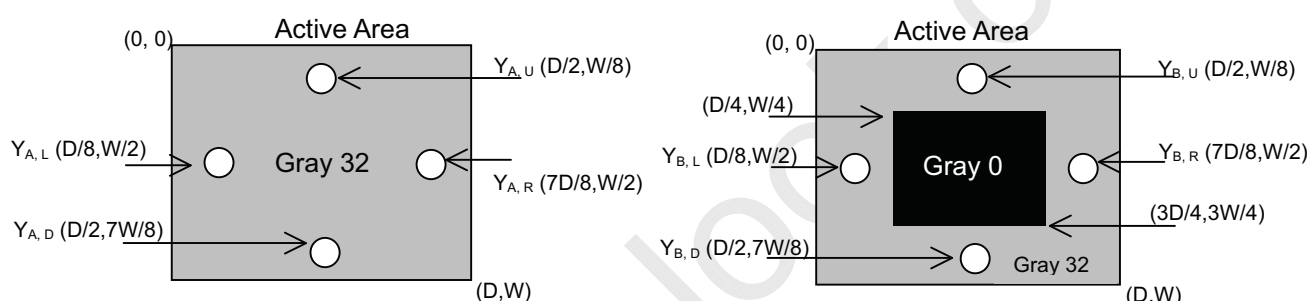
Note (5) Definition of Cross Talk (CT):

$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

Where:

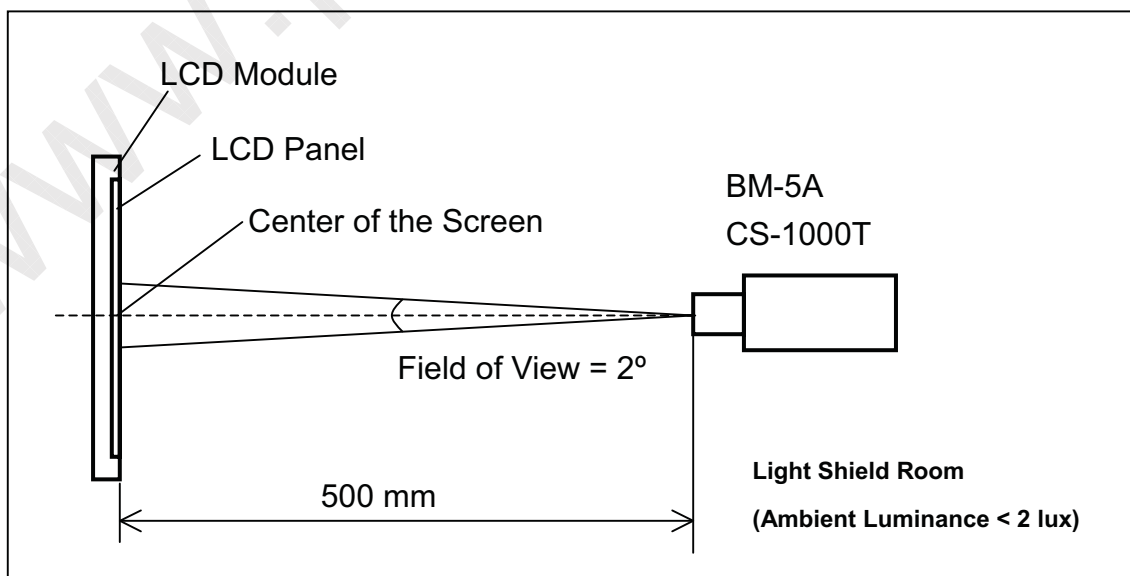
$Y_A$  = Luminance of measured location without gray level 0 pattern ( $\text{cd/m}^2$ )

$Y_B$  = Luminance of measured location with gray level 0 pattern ( $\text{cd/m}^2$ )



Note (6) Measurement Setup:

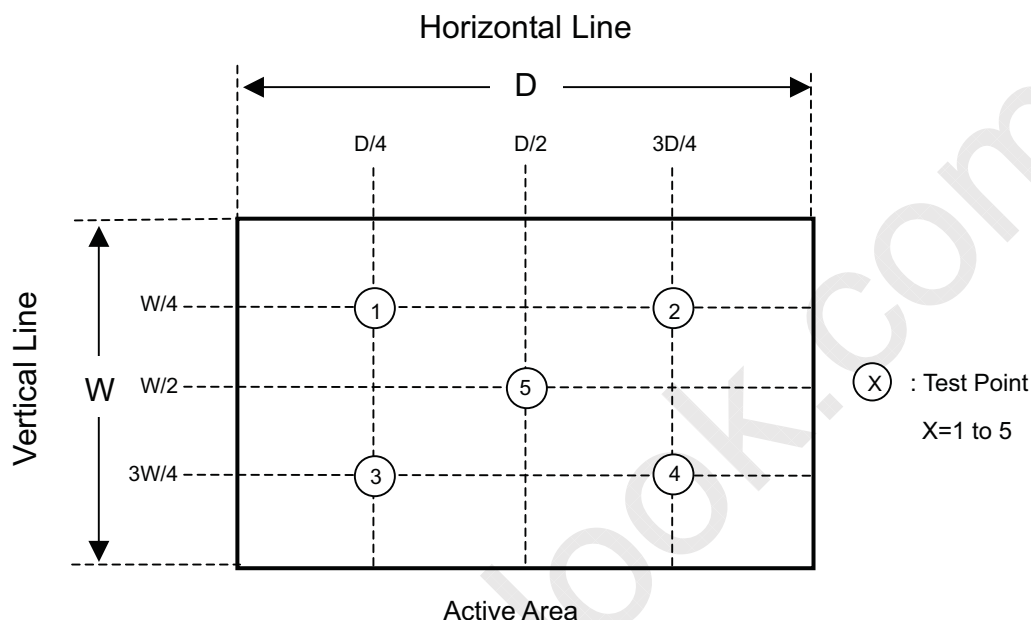
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.




**Note (7) Definition of White Variation ( $\delta W$ ):**

Measure the luminance of gray level 63 at 5 points

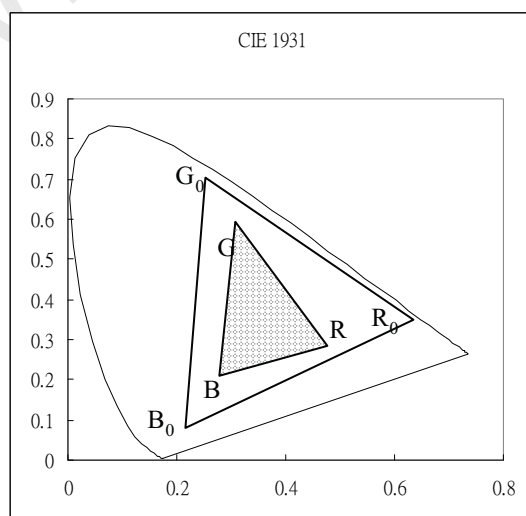
$$\delta W = \text{Maximum} [L(1), L(2), L(3), L(4), L(5)] / \text{Minimum} [L(1), L(2), L(3), L(4), L(5)]$$


**Note (8) Definition of color gamut (C.G%):**

$$C.G\% = \Delta R G B / \Delta R_0 G_0 B_0,$$

 $R_0, G_0, B_0$ : color coordinates of red, green, and blue defined by NTSC, respectively.

 $R, G, B$ : color coordinates of module on 255 gray levels of red, green, and blue, respectively.

 $\Delta R_0 G_0 B_0$ : area of triangle defined by  $R_0, G_0, B_0$ 
 $\Delta R G B$ : area of triangle defined by  $R, G, B$ 




## 8. PRECAUTIONS

### 8.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.
- (4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull the I/F connector in or out while the module is operating.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
- (9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly, and the starting voltage of CCFL will be higher than room temperature.

### 8.2 SAFETY PRECAUTIONS

- (1) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.
- (2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (3) After the module's end of life, it is not harmful in case of normal operation and storage.


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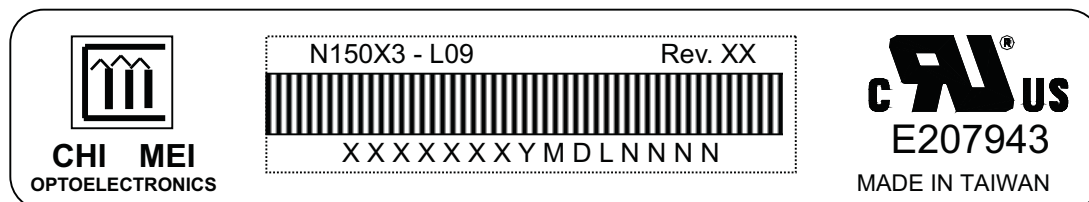
Model No.: N150X3 - L09

**Approval**

## 9. DEFINITION OF LABELS

### 9.1 CMO MODULE LABEL

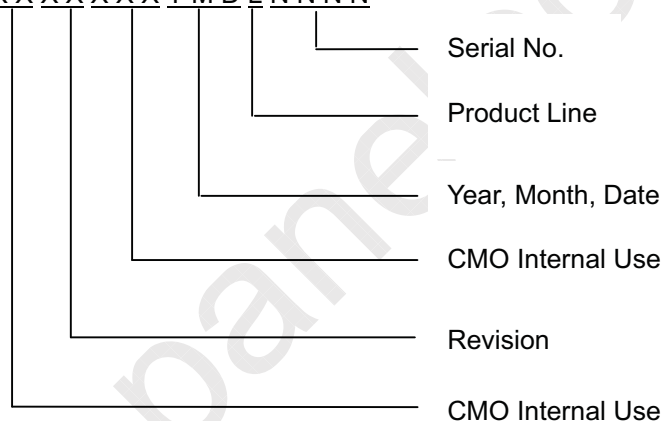
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



- (a) Model Name: N150X3 - L09
- (b) Revision: Rev. XX: WS, ES : A1, A2, A3,..., etc.  
CS & MP : C1, C2, C3,...,etc.

Note: It will happen that revision code changed without product changed in developing duration because of CMO internal stage change, for example: AX → B1, BX → C1.

- (c) Serial ID: XXXXXXYMDLNNNN



Serial ID includes the information as below:

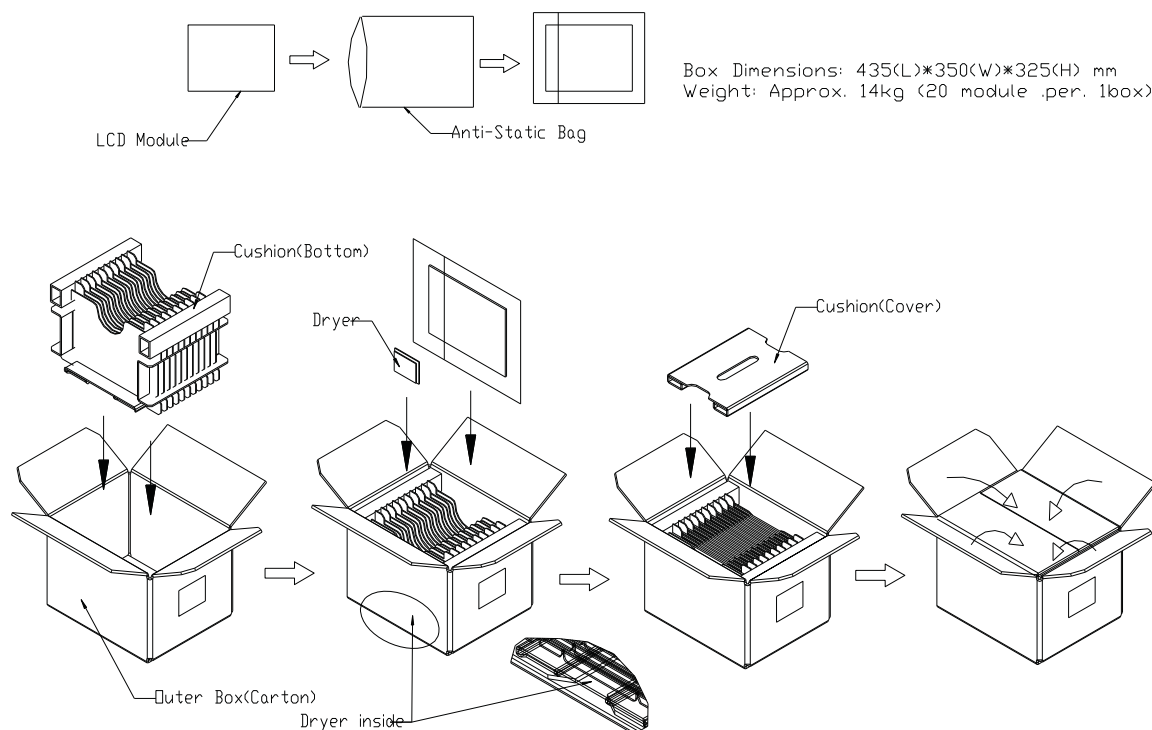
- (a) Manufactured Date: Year: 0 ~ 9, for 2000 ~ 2009.  
Month: 1 ~ 9, A ~ C, for Jan. ~ Dec.  
Day: 1 ~ 9, A ~ Y, for 1<sup>st</sup> to 31<sup>st</sup>, exclude I, O and U.
- (b) Revision Code: cover all the changes.
- (c) Serial No.: Manufacturing sequence of product.
- (d) Product Line: 1 -> Line1, 2 -> Line 2, ...etc.





## 10. PACKING

### 10.1 CARTON



### 10.2 PALLET

